REMARKS

In the Office Action dated September 11, 2002, the drawings were objected to under 37 C.F.R. §1.83(a) because the Examiner stated the plurality of lasers must be shown, as set forth in the claims.

In response, Figure 3 has been added which shows a perspective view of a laser bar which includes multiple lasers, in the form of multiple laser diodes. As discussed below, the claims have been amended to refer exclusively to a laser bar, rather than a laser array, and the specification and Abstract have been amended consistently with this amendment to the claims.

In general, a laser bar is a known device, and an example of a laser bar is disclosed in United States Patent No. 5,764,675, which was discussed at page 3 of the present specification which was cited in the Information Disclosure Statement filed January 3, 2001. The laser diodes in the laser bar described in that reference are vertically arranged, whereas the laser diodes employed in the illumination unit of the invention are horizontally arranged.

Moreover, the description in the specification as originally filed in the paragraph bridging pages 8 and 9 clearly refers to a laser bar, even though the item described in that paragraph was generally referred to as a laser diode array. Nevertheless, the term "monolithic laser bar" was used in the original language in this paragraph at page 9, line 6.

Therefore, the amendments to the specification, claims and Abstract, and the inclusion of Figure 3, are fully supported in the specification as originally filed, and no new matter is added thereby. The drawings are therefore submitted to be in full compliance with all provisions of 37 C.F.R. §1.83(a).

Typographical errors were noted in claims 6 and 16, which have been corrected.

Claims 1-3, 5, 6, 8, 9, 15, 16 and 20-22 were rejected under 35 U.S.C. §102(b) as being anticipated by Jewell et al. Claims 4, 7 and 10 were rejected under 35 U.S.C. §103(a) as being unpatentable over Jewell et al. in view of Hwu et al. Claims 17-19 were rejected under 35 U.S.C. §103(a) as being unpatentable over Yamamoto et al. Claims 11-14 were merely stated as being unpatentable under 35 U.S.C. §103(a), with no references being cited.

These rejections are respectfully traversed for the following reasons.

As noted above, the claims have been amended at all locations to refer to a laser bar, as opposed to a laser array. A laser bar, as discussed above, is a known type of laser arrangement, and therefore the usage of this term in claim 1 designates specific structural attributes of that component.

The Jewell et al. reference discloses a wafer scale optoelectronic package which, in contrast to a laser bar, employs a two-dimensional VCSEL laser diode array that emits laser radiation vertically relative to the wafer plane. The Jewell et al. reference provides explicit teachings that conventional edge-emitting semiconductor layers are not suitable for wafer scale packaging, at column 1, beginning at line 48.

The Jewell et al. reference therefore does not disclose or suggest an encapsulated illumination unit having a monolithic laser diode bar, as now set forth in the claims of the present application. This is because an edge-emitting laser diode bar is not suitable for the arrangement in the wafer scale package disclosed in Jewell et al. As noted above, the Jewell et al. reference explicitly teaches away from the use of a laser bar in such an arrangement.

Moreover, the Jewell et al. reference does not disclose or suggest a common carrier on which such a laser diode bar and an optical arrangement are mounted, as set forth in claim 1. Instead, the Jewell et al. reference teaches a VCSEL laser diode array with an optical chip disposed on top of the array. Thus, the optical chip is not mounted on a common carrier with the laser array, but is instead mounted on the laser array itself. In view of the above-noted requirement that VCSEL laser diode array be used in the Jewell et al. reference, and since this is not an edge-emitting array, it is not seen how the Jewell et al. reference could even be modified to dispose the optical chip and the laser diode array in Jewell et al. on a common carrier, since the optical chip would then not be able to interact with the laser beam emitted by the VCSEL array.

Lastly, the Jewell et al. reference does not disclose or suggest a covering which encapsulates the aforementioned common carrier, and the Examiner did not provide any citations to the language in the Jewell et al. reference which would allegedly provide such a teaching.

The Jewell et al. reference therefore does not disclose all of the elements of claim 1 as arranged and operating in that claim, and therefore does not anticipate claim 1 nor any of the claims depending therefrom.

As to claims 4, 7 and 10, the Examiner relied on the Hwu et al. reference as disclosing a ceramic substrate with a recess therein, and with a mirrored surface on the substrate. For the reasons noted above, even if the Jewell et al. reference were modified in accordance with these teachings, a structure comparable to the subject matter of claims 4, 7 and 10 still would not result, since each of those claims embodies the subject matter of independent claim 1, which is not disclosed or

suggested in the Jewell et al. reference. Moreover, for the reasons noted above regarding the necessity of placing the optical chip on top of the VCSEL laser array in the Jewell et al. reference, it is not seen how the operability of the Jewell et al. reference could even be preserved if it were modified in accordance with the teachings of Hwu et al. Modifying a reference so as to destroy its intended manner of operation is not a permissible basis for justifying a rejection under 35 U.S.C. §103(a).

As noted above, the Office Action states claims 17-19 were rejected under 35 U.S.C. §103(a) as being unpatentable over Yamamoto et al. Since the Examiner merely relied on the Yamamoto et al. reference as disclosing the use of Peltier elements to provide cooling or temperature control to the substrates of a laser system, and since the Examiner did not identify any features of claim 1, from which claims 17-19 depend, in the Yamamoto et al. reference, Applicants assume the Examiner intended to reject claim 17-19 under 35 U.S.C. §103(a) as being unpatentable over Jewell et al., using the Yamamoto et al. reference as a secondary reference. For the reasons noted above, however, even if the Jewell et al. reference were modified in accordance with the teachings of Yamamoto et al., an illumination unit as set forth in claims 17-19 still would not result, since those claims embody the subject matter of independent claim 1 therein.

Similarly, Applicants assume the Examiner did not intend to reject claims 11-14, which also depend from independent claim 1, solely on the basis of the well-known use of adhesives or solder to bond structural elements in the laser art. Applicants assume the Examiner intended to reject claims 11-14 based on the teachings of Jewell et al., using this well-known knowledge in the art as a secondary

teaching. For the reasons discussed above, however, even if the Jewell et al. reference were modified in accordance with this well-known information, an illumination unit as set forth in claims 11-14, which embody the subject matter of claim 1 therein, still would not result.

All claims of the application are therefore submitted to be patentable over the teachings of the references relied upon by the Examiner, as well as over the teachings of all of the references of record.

An editorial amendment has been made in the title, since the specification clearly describes other uses for the claimed illumination unit besides usage in the medical field.

Early reconsideration of the application is respectfully requested.

Submitted by,

Steven H. Noll (Reg. 28,982)/

SCHIFF, HARDIN & WAITE
CUSTOMER NO. 26574
Patent Department
6600 Sears Tower
233 South Wacker Drive
Chicago, Illinois 60606
Telephone: 312/258-5790
Attorneys for Applicants.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION

Please amend the paragraph beginning at page 4, line 13 as follows:

This object is achieved in accordance with the present invention in an illumination unit having a monolithic semiconductor laser diode [array] bar with separately driveable drivable laser diodes that emit radiation, as well as at least one optical arrangement for collimating and/or focusing the emitted laser beam, the laser diode [array] bar and the optical means being arranged at a common carrier, and wherein the laser diode [array] bar is connected to a pin-like terminal elements at the carrier for diode drive, the pin-like terminal elements being in turn connectable or connected to a terminal arrangement provided at a carrier plate that accepts the carrier, and having a radiation-transparent covering that encapsulates the carrier.

Please amend the paragraph beginning at page 5, line 21, as follows:

The laser diode [array] bar or the individual diodes themselves are connected to the pin-like terminal elements with bond wires. Each laser diode thus can be directly connected to a pin-like terminal elements via a bond wire for forming a p-contact. Further, the side of the carrier that accepts the laser diode array can be at least partly covered with an electrically conductive layer, particularly a gold layer, to which the laser diode [array] bar placed on the layer is electrically connected, and that is connected to at least one pin-like terminal means via a bond wire for forming an n-contact for the laser diode [array] bar. As a result, the required p-contacts as well as the at least one n-contact that are required for the separate drive can be produced in a simple way.

Please amend the paragraph beginning at page 6, line 7, as follows:

In order to be able to implement the illumination units in as stable a fashion as possible, it has proven expedient to provide a laterally closed recess at the carrier in which the laser diode [array] bar and the optical means are arranged, with the radiation-transparent covering being a plate or disk that closes the recess. A recess closed on all sides is provided for the acceptance of the relevant elements at the carrier, which is preferably a multi-layer ceramic carrier, this recess, of course, being deep enough so that the elements can be completely accepted therein. The ceramic carrier offers adequate protection on all sides and is sufficiently stable; the recess itself is then merely closed with the plate-like covering, so that a complete encapsulation is established with a simple design of the carrier as well as the covering.

Please amend the paragraph beginning at page 6, line 17, as follows:

It has proven especially advantageous for fabrication-related reasons when the optical arrangement is a pre-fabricated component part. The optical arrangement is placed completely on the carrier, which offers a considerable simplification in the assembly. The optical arrangement can be pre-fabricated as a module in this embodiment of the invention, with micro-lens systems for collimation and/or focusing as well as, if used, the deflection mirror, are arranged, for example, on a small, common carrier. The individual elements of the optical arrangement, of course, are matched to the employed laser diode [array] bar, i.e. the succession of micro-lenses of the respective focusing systems and their number as well as the length of the deflection mirror are adapted to the spacing and number of individual laser diodes of the [array] bar as well as to the overall length of the array, the optical

arrangement also can be matched to the emitted radiation, etc. This embodiment allows the pre-fabricated component part to be specifically designed for a laser diode [array] bar, such as a modular system for each laser diode [array] bar employed.

Please amend the paragraph beginning at page 7, line 15, as follows:

It has proven advantageous for securing the individual elements to the carrier to secure the laser diode [array] bar and the optical arrangement and possibly the covering as well, to the carrier with a glued connection, preferably upon using a temperature-resistant adhesive. A conductive adhesive is expediently employed for gluing the laser diode [array] bar since the electrical contacting to the gold coating is realized thereby. The covering itself should be composed of glass, particularly anti-reflection coated glass. The laser diode [array] bar can alternatively be secured with a solder connection.

Please amend the paragraph beginning at page 7, line 22, as follows:

When the laser diode bar is operated with low power < 15 mW, the heat that thereby arises is unproblematic and can be eliminated via the carrier. Given higher laser powers in the range between 15 mW - 100 mW, this is not always possible, for which reason an arrangement for cooling the carrier is provided at the carrier, particularly in the region of the laser diode [array] bar, in order to avoid an overheating, and thus a premature aging, of the laser diode [array] bar. This cooling arrangement is preferably a Peltier element. This is connected via contact pins to a regulator, so that the cooling capacity can be regulated as needed.

Please amend the paragraph beginning at page 8, line 22, as follows:

Figure 1 shows a first embodiment of an illumination unit 1 having a carrier 2, preferably a multi-layer ceramic carrier, at which a recess 3 is provided that is

laterally closed via side walls 4 on all sides. A laser diode array in the form of a laser bar 5 with a number of separately addressable and driveable, individual laser diodes as well as an optical arrangement 6 are accepted in this recess 3. The laser bar 5 is shown in a side (end) view in Figure 1. The monolithic laser diode [array] bar 5 typically has dimensions of length x width x height = 10 mm x 0.6 mm x 0.115 mm. The spacing of the laser diodes from one another can be between 50 μm through 2000 μm. Lengths of the monolithic laser bar 5 between 1 mm and 30 mm can be technologically realized. Any known material can be employed as semiconductor material; this is based on the desired wavelength. The bandwidth should be extremely narrow and lie in the range of +/- 3 nanometers. Due to the monolithic array technology, a uniform radiation power and directional characteristic of all laser diodes is established, so that every diaphanoscopic image a data registration produced on the basis of the emission of one of the laser diodes is comparable to the others. The optical power (cw) should lie between 10 mW and 200 mW per individual laser diode element, whereby the optical power for the medical application should lie in the region of <100 mW/mm^2 given a laser beam diameter of <300 μm in the focus. The preferred diameter of a laser beam spot amounts to approximately 150 μm through 200 μm.

Please amend the paragraph beginning at page 10, line 1, as follows:

For realizing an n-contact of the laser diodes, first, the recess 3 is occupied with a conductive layer 11, preferably a vapor-deposited gold layer. The laser diode [array] bar 5 is glued onto this conductive layer 11 with a soldered connection or a conductive, temperature-resistant glued connection 33, whereby the adhesive is also preferably temperature-resistant. The conductive layer 11 is in turn connected via on

or more bond wires 12 to a further pin-like terminal element 13, which is integrated into the ceramic carrier 2 in a manner corresponding to that of the pin-like terminal element 8.

Please amend the paragraph beginning at page 11, line 8, as follows:

A further recess 24 that is arranged under the laser diode [array] bar 5 and is provided for the acceptance of an element 25 for cooling the carrier is provided at the carrier 2. The element 25 is preferably a Peltier element. The cooling element 25 can be connected via corresponding terminals 26 to a regulator via which the cooling capacity can be regulated. The employment of a cooling element 25is expedient, particularly given laser powers >15 mW, since a complete heat elimination via the carrier 2 is then no longer assured and possible temperature elevations can lead to a deterioration of the laser diode array 5. Of course, the terminals 26 can again be fashioned as pin-like terminal elements that exit laterally at the ceramic carrier 2.

IN THE CLAIMS

Please amend claim 1 as follows:

1. (Amended) An illumination unit comprising:

a monolithic semiconductor laser diode [array] bar containing a plurality of individually driveable laser diodes, each of which emits radiation;

an optical arrangement for at least one of collimating and focusing said radiation for producing a radiation beam having a substantially circular cross-section;

a common carrier on which said laser diode [array] bar and said optical arrangement are mounted;

a plurality of pin-like terminal elements at said carrier electrically connected to said laser diode [array] bar for transmitting drive signals to said laser diodes; and

a covering that is transparent to said radiation and which encapsulates said carrier.

Please amend claim 6 as follows:

6. (Amended) An illumination unit as claimed in claim 5 wherein each of said laser diodes is directly connected to one pin-like element via a respective bond wire for forming a p-contact, and wherein said carrier [as] has an electrically conductive layer at a side of said carrier at which said laser diode array is mounted, said electrically conductive layer being connected to at least one of said pin-like terminal elements via a bond wire and forming an n-contact for said laser diode [array] bar.

Please amend claim 7 as follows:

7. (Amended) An illumination unit as claimed in claim 1 wherein said carrier has a laterally closed recess in which said laser diode [array] bar and said optical arrangement are disposed, and wherein said covering comprises a flat element closing said recess.

Please amend claim 11 as follows:

11. (Amended) An illumination unit as claimed in claim 1 wherein said laser diode [array] bar and said optical arrangement are secured to said carrier with a glued connection.

Please amend claim 14 as follows:

14. (Amended) An illumination unit as claimed in claim 1 wherein said optical arrangement is secured to said carrier with a glued connection and wherein said laser diode [array] bar is secured to said carrier with a soldered connection.

Please amend claim 16 as follows:

16. (Amended) An illumination unit as claimed in claim 15 wherein said covering is comprised of [ant-reflection] anti-reflection coated glass.

Please amend claim 18 as follows:

18. (Amended) An illumination unit as claimed in claim 17 wherein said cooling element is disposed at said carrier at a region of said laser diode [array] bar.

IN THE ABSTRACT

Please amend the Abstract as follows:

Illumination unit for an apparatus, particularly for the implementation of diaphanoscopic examinations at a human, animal or botanical examination subject, [HAS] has a monolithic semiconductor laser diode [array] bar with driveable laser diodes that emit radiation as well as at least one optical arrangement for collimating and/or focusing the emitted laser radiation. The laser diode [array] bar and the optical arrangement are mounted at a common carrier, and the laser diode [array] bar is connected to pin-like terminal elements at the carrier for diode drive, that are in turn connected or connectable to terminals provided at a carrier plate accepting the carrier. A radiation-transparent covering that encapsulates the carrier.